STATE OF CALIFORNIA—THE RESOURCES AGENCY
EDMUND G. BROWN JR., Governor

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER QUALITY
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MAR 3 - 1978

In Reply Refer
to: 510:CS

Members of Technical Advisory
Committee
South Bay Dischargers Authority
801 North First Street
San Jose, CA 95110

LESLIE SALT BITTERN DISPOSAL STUDY

A meeting of the South Bay Dischargers Authority Technical Advisory Committee has been scheduled for Monday, March 20, 1978 at 9:30 a.m. The meeting will be held in the First Floor Assembly Room, San Francisco Bay Regional Water Quality Control Board, 1111 Jackson Street, Oakland, California.

The topic of the meeting will be a section of the draft EIS entitled "Environmental Impacts of the Discharge of Leslie Salt Company Bittern through a Diffuser Near the Dumbarton Bridge".

This meeting will be the final meeting to discuss this section of the South Bay Dischargers Authority draft EIS.

A copy of the Leslie Salt Bittern Chapter is included for your review. Appendices B, C, and D of Salt Chapter Appendix 6.1 and Appendices I through VIII of Salt Chapter Appendix 6.2 have not been included with this enclosure. These portions of the chapter consist of data compilation sheets for the mathematical modeling and biological survey relative to the bittern disposal study. Those TAC members who desire a copy of these appendices may request a copy by contacting me by phone.

Again, this is the final meeting about this chapter of the draft EIS, and your participation is appreciated. If you have any questions, please call me at (916) 445-9725.

Curtis N Swanson

Curtis Swanson
WRC Engineer

Enclosure

STATE OF CALIFORNIA—THE RESOURCES AGENCY EDMUND G. BROWN JR., Governor

STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER QUALITY
P. O. BOX 100 • SACRAMENTO 95801
(916) 445-7971

March 2, 1978

In Reply Refer
to: 510:CS

Members of Technical Advisory Committee:

Attached is a review draft (handwritten corrections and rough sketches to illustrate general placement and content of figures) of the study of the potential for impact if the Leslie Salt Company were to discharge bittern to San Francisco Bay through the SBDA diffuser. Alternative disposal methods are those conceptually developed by Leslie Salt and its consultants, CDM, Incorporated, in two studies since 1972.

The reviewer should note that this is not a draft EIR/EIS for Leslie Salt participating with SBDA should SBDA build a discharge system north of Dumbarton Bridge. For this reason, this report is written as Chapter VI of the SBDA Draft EIR/EIS on disposal alternatives and is heavily cross referenced to Chapters I - IV in that EIR/EIS.

The attached appendices will be incorporated into the appropriate EIR/EIS appendices - 6.1 into EIR/EIS Appendix C (Hydroscience model runs) and 6.2 into Appendix H (Biological Surveys).

Comments on the content and conclusions presented in this report are requested in letter form by the next TAC meeting date (scheduled March 20, 1978) so that the appropriate revisions can be incorporated. Such comments should be sent to:

Curtis Swanson
SWRCB
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with copies to:

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copied only
Ch V1.1 - V1.2

THE ENVIRONMENTAL IMPACTS OF THE DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NEAR DUMBARTON BRIDGE

October 15, 1976

VI. THE ENVIRONMENTAL IMPACTS OF THE DISCHARGE OF LESLIE SALT COMPANY BITTERN THROUGH A DIFFUSER NORTH OF DUMBARTON BRIDGE

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VI.1 DESCRIPTION OF LESLIE SALT COMPANY DISPOSAL ALTERNATIVES

The Leslie Salt Company, as described in Sections II.1.2 and II.1.3, produces salt from approximately 35,000 acres of salt ponds around San Francisco Bay, 26,500 acres of which are found in the South Bay area. As a by-product of the final stages of salt production, a liquor, or highly concentrated brine solution, is produced. This liquor, termed bittern, has had, in the past, a significant commercial value as a source of magnesium, bromine, and gypsum salts (CDM, 1972). However, in the early 1970's, the market for bittern diminished, and when Leslie Salt Company began to dispose of the bittern by disposal to Newark Slough, they were asked by the Regional Water Quality Control Board to investigate various alternative means of bittern disposal.

For the past five years, the bittern has been stored in ponds near the Newark, California, salt plant. CDM (1972) analyses of this stored bittern indicated that as much as 201 million gallons of bittern are produced and stored per year. At this rate of production, Leslie Salt Company has had to convert productive salt ponds into bittern storage ponds, reducing production capacity. However, direct discharge of the bittern into the Bay or extremities of the Bay is environmentally unacceptable.

CDM (1972) performed chemical analysis of the bittern (Table VI-1) and determined that undiluted bittern was highly toxic. A 96-hour bioassay determined that the tolerance limit median (TLm), or the concentration of a substance required to kill 50 percent of the test organisms, ranged from 1.4 to 2.0 percent of the bittern. In other words, a minimum dilution of 100:1 was required to maintain a 100-percent survival of test fishes over a 96-hour period.

1976 values

Table VI-1

CHEMICAL ANALYSIS OF BAY WATER AND BITTERN[1]

Constitutent	Bay Water[2]	Bittern 1:1[2]	Bittern Undiluted[3]
pH	8.1	7.8	7.05
Total Solids (ppm)	30,631	241,550	618,450
Total Volatile Solids (ppm)	5,488	86,600	332,580
Total Suspended Solids (ppm)	44	1,760	1,240
Total Dissolved Solids (ppm)	30,587	239,790	617,210
Alkalinity as $CaCO_3$ (ppm)	194	2,800	3,500
BOD (ppm)	1.2	198	240
COD (ppm)	225	6,350	8,000
Ammonia as N (ppm)	0.06	0.702	3.75
Kjeldahl Nitrogen Total (ppm)	1.10	32.610	38.80
Nitrate as N (ppm)	0.72	37.50	--
Phosphorus Total as P (ppm)	0.41	0.22	6.66
Chloride (ppm)	17,000	158,000	352,000
Cyanide (ppm)	<0.04	<0.04	<0.04
Fluoride (ppm)	1.21	74.90	75.0
Phenols (ppb)	<6	64.10	172
Sulfate as S (ppm)	2,400	21,000	20,600
Sulfide as S (ppm)	<2	<2	<2
TOC (ppm)	18.5	900	2,700
Aluminum (ppb)	200	2,500	2,800
Arsenic (ppb)	<10	40	60
Cadmium (ppb)	<20	<20	<20
Calcium (ppm)	380	450	50
Chromium (ppb)	<20	<20	<20
Iron (ppb)	20	6,500	75
Lead (ppb)	<20	<20	20
Mercury (ppb)	<1	<1	2
Sodium (ppm)	7,500	5,500	30,000
Titanium (ppb)	<20	<20	<20
Zinc (ppb)	30	190	80
Copper (ppb)	--	--	20
Nickel (ppb)	--	--	<20
Silver (ppb)	--	--	<20

(1) All tests by Standard Methods, 13th Edition, except Hg, Ti by WQO.
(2) Samples collected February 16, 1972 (CDM, 1972).
(3) Samples collected February 29, 1975 (CDM, personal communication, 1975).

For this reason, direct discharge of undiluted bittern to Newark Slough is not an environmentally sound disposal method. Leslie Salt Company has proposed a number of alternatives of disposal of the bittern. Two of these alternatives will be analyzed in this section.

VI.1.1 LESLIE SALT BITTERN DISCHARGED VIA SBDA DIFFUSER

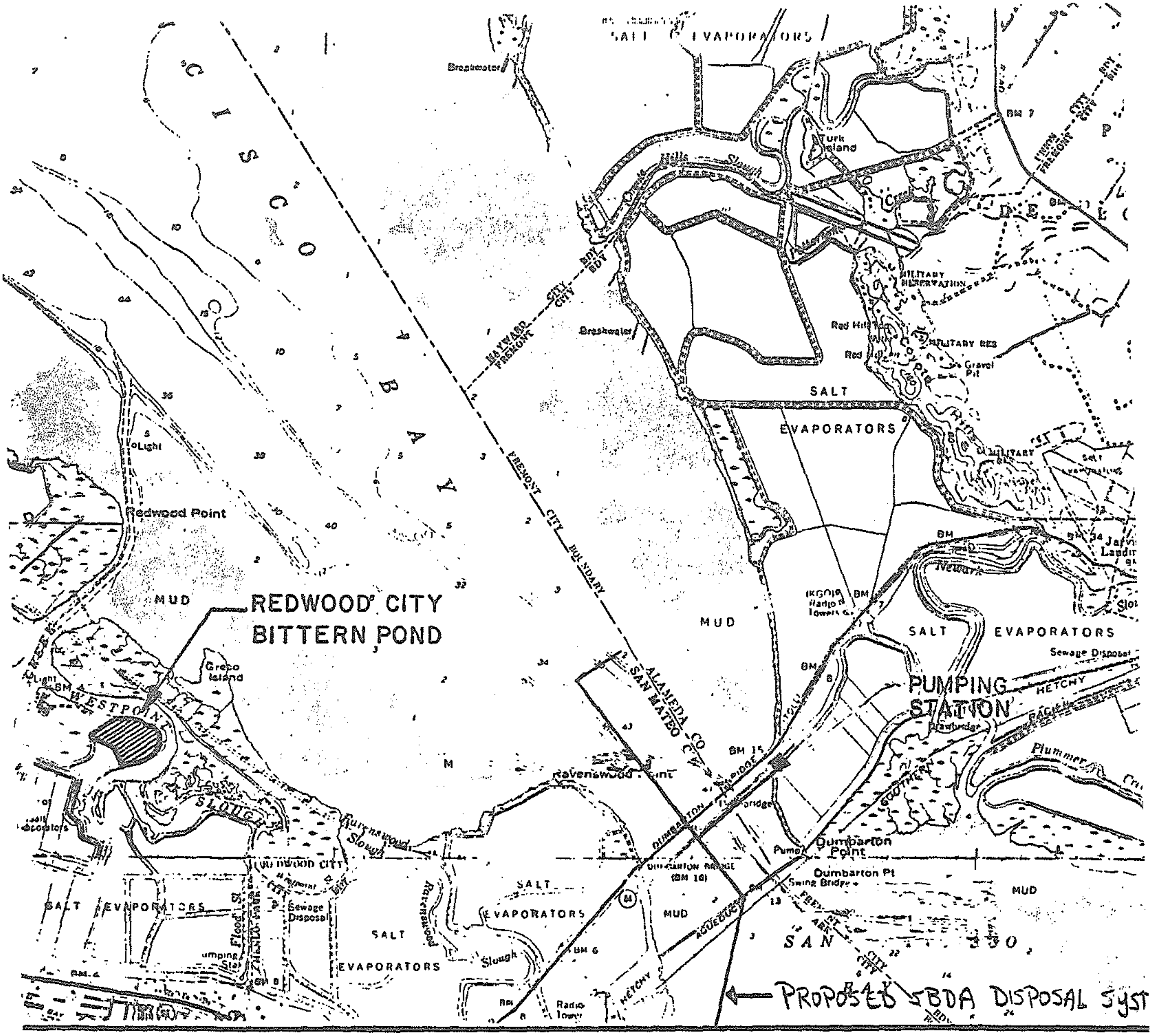
One source of water for dilution readily available to Leslie Salt Company is treated wastewater currently being discharged to San Francisco Bay. A number of discharger authorities and regional facility management plans have been established; these include the East Bay Dischargers Authority, the South Bay Dischargers Authority, the South Bayshore Authority, and others. In order for this wastewater to be an acceptable diluent for Leslie Salt Company bittern, the following conditions must be met:

- Sufficient quantities of water must be available to dilute bittern. A 100:1 dilution ratio is the minimum level allowable for disposal.
- The Leslie Salt Company discharge to the wastewater outfall must be designed to minimize impact on treatment facilities, reclamation plans, and other wastewater management plans. Since the bittern cannot be effectively treated, discharge directly to the disposal outfall is the most favorable method.
- Participation of Leslie Salt Company in a discharger's outfall should be considered in outfall design and location. Those dischargers utilizing existing outfalls should have sufficient capacity in their outfalls in order for Leslie Salt Company to participate.

In communication with the various discharger authorities on these issues, Leslie Salt and the Regional Water Quality Control Board determined that the best available source of wastewater as a diluent was South Bay Dischargers Authority. To this end, CDM performed a study (1975) on the water quality impacts expected from discharge of bittern diluted with wastewater of a quality similar to that predicted in the South Bay Dischargers Authority 1972 feasibility study (Consoer-Bechtel, 1972). This report concluded that, using the effluent quality and quantity expected from the combined plants (then assumed to be the Union Sanitary District, San Jose/Santa Clara, Palo Alto, and San Mateo), toxicity requirements could be met. It should be noted that the South Bay Dischargers Authority now consists of San Jose/Santa Clara, Sunnyvale, and Palo Alto; wastewater quality and quantity vary from that predicted in the Consoer-Bechtel (1972) report.

Analysis of the impacts of South Bay Discharger wastewater on the water quality and biology of the South Bay was made with the assumption that Leslie Salt Company would continue storing bittern (i.e., a zero-discharge mode). However, recent communications from the Regional Water Resources Control Board to Leslie Salt Company and the South Bay Dischargers Authority indicate that the best alternative for Leslie Salt Company may be discharge of the bittern through the diffuser of the South Bay Dischargers Authority proposed project. For purposes of this study, a Leslie Salt Company-SBDA discharge system was assumed to be as follows:

- The Leslie Salt bittern would be pumped to the SBDA pipeline via a buried 6-inch pipeline.
- The Leslie Salt pumping station would be located at an existing pumping station on the dike at Salt Pond No. 3, and the point of tie-in to the SBDA pipeline would be upstream of the diffuser near the Dumbarton Bridge.
- In order to protect against reverse flows, a check valve would be provided in the Leslie Salt pipeline along with a gate valve to permit repairs to the pumping station.
- In addition, flow metering would be required on the down stream side of the pumping station.



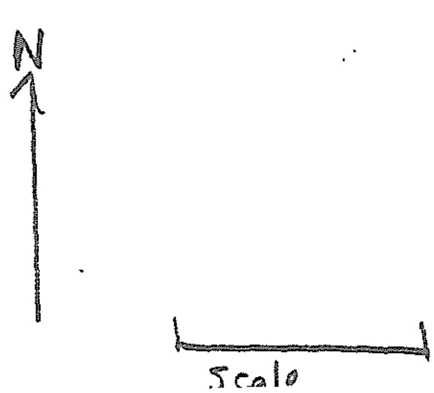


FIGURE VI-1
LESLIE SALT COMPANY
BITTERN DISPOSAL
SYSTEM - DISCHARGE
TO SBDA DIFFUSER

VI.1.2 LESLIE SALT BITTERN DISCHARGED THROUGH A SEPARATE DIFFUSER

Another source of diluent for the bittern is San Francisco Bay water. CDM (1972) proposed such a discharge system which would be designed to obtain maximum dilution benefit from Bay currents. Using a diffuser near the Dumbarton Bridge, bittern would be discharged during the six winter (wet) months of the year, for about two and one-half hours of each tidal cycle during maximum flow of ebb tide.

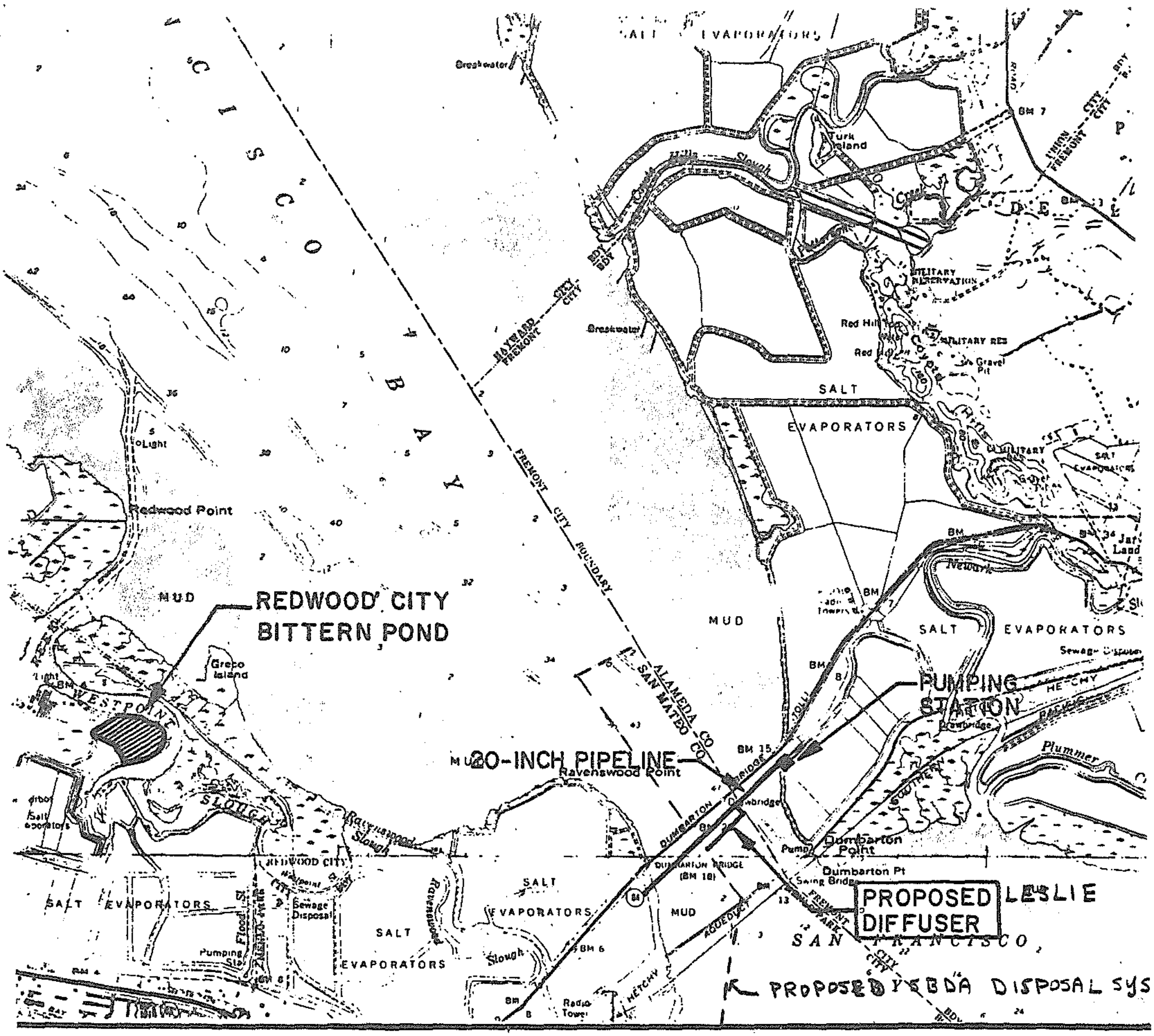
For purposes of their study, the CDM (1972) conceptual design for a 24-inch diameter diffuser was used. This diffuser, 625 feet long with one-inch diameter ports spaced on six-foot centers, would be connected to the existing 20-inch pipeline across the Bay. The existing pump on the east shore of the Bay would be replaced. Using design flows of 11.0 million gallons per day (5.5 m.g.d. bittern diluted 1:1 with Bay water) and design dilution of 100:1 before the plume hits the bottom of the Bay, the plume was calculated to extend approximately 3 meters horizontally and 1.7 meters vertically from the point of discharge, with a vertical thickness and horizontal thickness of about 0.5 meters and 1.8 meters, respectively (CDM, 1972). A bottom area of at least 130 square feet would be exposed to a dilution of between 200:1 and 400:1 (CDM, 1972). The location of this disposal system is shown in Figure VI.2.

However, in the model analysis of this alternative, year-round flows of 0.55 million gallons per day of unduluted bittern were assumed, and design of a disposal system for these flows might differ significantly from the DCM 1972 design.

VI.1.3 OTHER DISPOSAL ALTERNATIVES

Continued Storage

Using existing and new ponds, bittern would be stored indefinitely on Leslie Salt Company property. This alternative was the assumed condition for the description and analysis of the SBDA pipeline in Sections I through V of this report.



SOURCE: CDM, 1972

FIGURE VI-2

LESLIE SALT COMPANY
BITTERN DISPOSAL
SYSTEM - SEPARATE
DIFFUSER

N

Scale

Since approximately 201 million gallons per year of bittern are produced, additional salt production ponds would have to be converted to bittern storage. Reduced production of salt would eventually result in an uneconomical enterprise (CDM, 1972). Additionally, the United States Fish and Wildlife Service (USFWS) has expressed concern over the conversion of salt ponds to bittern storage and/or the reduction of salt production. Since a large portion of the Leslie Salt Company holdings in Alameda County are within the San Francisco Bay National Wildlife Refuge, any change in the biological productivity of the salt ponds is of concern to the USFWS. Conversion to bittern reduces biological productivity by increasing the area of toxic water surface in the refuge; reduction or cessation of salt production alters the variation in salinity in the chain of salt ponds within the refuge. For these reasons, this alternative is not considered to be a viable alternative, and will not be discussed further in this section.

On-land Dilution

The California Department of Fish and Game has expressed concern that the zone of toxicity (the portion of the plume with less than 100:1 dilution) could have adverse impacts on the recovering striped bass fishery in the South Bay as well as impacts on other fish and benthic species, if the bittern were discharged through a separate diffuser system (Section VI.1.2).

In order to minimize the zone of toxicity, the bittern could be diluted 100:1 with Bay water in an on-land facility and then discharged through a diffuser to the Bay. Such an alternative would require a larger discharge pipe than for disposal of undiluted bittern as well as a water supply pipe from the Bay and on-land facilities large enough to hold bittern and Bay water. This alternative would require the commitment of Baylands or the conversion of additional salt production ponds. Since the majority of the Leslie Salt Company holdings in this area are within the San Francisco Bay National Wildlife Refuge, conversion of property for the purposes of on-land dilution would be of concern to the United States Fish and Wildlife Service. Also of concern to the Fish and Wildlife Service is the entrainment of organisms from Newark Slough, a potential diluent source, as a result of pumping. This entrainment would result in a loss of these organisms, a significant impact on the slough's biota.

For this reason, this alternative was not considered viable and will not be discussed further in this section.

VI.2 PRESENT ENVIRONMENT

The existing environmental setting of the South San Francisco Bay is described in Section II of this report. The following discussion is a summary of the environmental conditions in the vicinity of the Dumbarton Bridge.

VI.2.1 PHYSICAL ENVIRONMENT

Topography

In the vicinity of Dumbarton Bridge, San Francisco Bay narrows to a width of approximately 6,200 feet (1,880 meters) at mean higher-high water (MHHW) and has a maximum depth of about 40 feet (12 meters). At mean lower-low (MLLW) the width narrows to approximately 3,300 feet (1,000 meters). The low-lying Baylands that comprise the area from the Bay shore line to the 10-foot contour above mean sea level consist of salt evaporators, sloughs, marshes, and tidal mudflats. An extensive system of dikes and levees separate the salt evaporator system from the other portions of the Bay, and therefore constitute a major influence on the human and biological uses of the Dumbarton Straits.

Soils

Harlan Engineers and Applied Soil Mechanics (1973) reported that subsurface conditions at Ravenswood Point, in the vicinity of the western abutment of Dumbarton Bridge, consist primarily of soft clays underlain by firm to stiff clays and moderately dense to dense sands. The soft clays are between 13 and 55 feet deep, deepening at the Bay shore.

The Environmental Protection Agency (EPA) reports similar soil conditions for that portion of the Baylands at the eastern abutment of Dumbarton Bridge. In the Draft Environmental Impact Statement for East Bay Dischargers Authority, the EPA (1975) indicates Bay Mud deposits from five feet to 60 feet thick, corresponding generally to the "tidal flats" soil unit described by the U.S.G.S. (1971).

Where used for foundation purposes, Bay Mud may subside, settle differentially, fail by shearing, shrink and crack when dry or expand and become plastic when wet. Bay Mud also has a high potential for lurching and sliding during earthquake tremors.

Sediments

Sediments near Dumbarton Bridge are comprised of a thick layer of Bay Mud underlain by a layer of moderately dense to very dense sand and silt. Typical sediment characteristics for this area are given in Table II-2, boring locations E1, E2 and E3 (Figure II-4). Table VI-2 compares these sediment analyses with EPA dredge spoil characteristics; the sediments from this area meet all EPA criteria and may be disposed of in open water, as proposed, at the Alcatraz disposal site.

Table VI-2

SEDIMENT SAMPLE ANALYSES AND EPA (1975) DREDGE SPOIL DISPOSAL CRITERIA FOR POLLUTED SPOIL
Concentration (ppm, dry weight)

Pollutant Measured	Boring Location E1	E2	E3	EPA Criteria
Mercury	0.33	0.06	0.05	1.7
Cadmium	<1.2	<0.9	<0.9	3.2
Lead	14.6	7.0	6.6	110.0
Zinc	75.8	38.7	29.3	250.0
Oil and Grease	485	194	187	2800

Hydrology

Two high and two low waters occur each day with typical diurnal variations in both their magnitude and timing of occurrence. The mean tide range at the Golden Gate is about four feet, whereas at Dumbarton Bridge, the tidal movement virtually produces a standing wave and the mean tidal range is nearly seven feet (CDM, 1972). The maximum tidal fluctuation at Dumbarton Bridge between MLLW and MHHW is about 13.5 feet (U. S. Army Corps of Engineers, personal communication, 1975).

Table II-5 presents typical variations in ebb tide current velocities near Dumbarton Bridge while Table II-6 illustrates the typical tidal cycle in surface water near the Bridge. Tidal flushing is substantial at the Strait but decreases north and south of the Bridge as the width of the Bay increases.

Water Quality

Temperature and Salinity. Table VI-3 presents the results of a 1969 survey of water temperature and salinity at Dumbarton Bridge, as reported by CDM (1972). CDM reports these values to be typical of ambient winter conditions in the Bay at that location. Additional measurements by Bionomics Corporation for this report (Appendix H) are also presented in Table VI-3 for comparative purposes. The differences in temperature and salinity can be attributed to seasonal variability; increased temperature and salinity are typical of dry season conditions (see also Figure III-2).

Chemical Characteristics. Table VI-4 lists some of the chemical parameters measured during two seasons in the vicinity of Dumbarton Bridge. Some parameters, such as BOD, compare favorably with the Lower and Central Bay values given in Table II-7. Others, such as nitrate, fall within South Bay ranges, which are generally higher than other portions of the Bay. In general, the Dumbarton Straits have relatively good water quality and are subject to some of the flushing effects which maintain good water quality in the Lower and Central Bays.

VI.2.2 BIOLOGICAL ENVIRONMENT

Open Water and Tidal Mudflats

As reported by Bionomics Corporation (Appendix H), the common benthic organisms in the Dumbarton Bridge area include species which seem to show a strong seasonal variation. Table VI-5 shows those species found at five Dumbarton Bridge vicinity stations and one Ravenswood Point station in October 1975. These species are typical of the predominantly mud bottom and, in the tidal mudflats, provide a food source for fishes, wading birds and other carnivores.

Salt Marsh

As shown in Figure II-14, the salt marsh communities in the Dumbarton Bridge vicinity consist of bands of marsh, or "eyebrows", along the fringes of salt ponds and sloughs. The major marsh near the western abutment of

Table VI-3

VARIATION IN SALINITY AND TEMPERATURE
AT DUMBARTON BRIDGE

Depth in Meters		Date of Observation			
		1/31/69(1)	2/7/69(1)	10/18/75(2)-N	10/18/75(2)-S
0	T(3)	9.25	10.46	--	--
	S(4)	14.42	12.51	--	--
0.5	T	--	--	--	17.00
	S	--	--	--	27.27
1.0	T	--	--	17.00	--
	S	--	--	27.83	--
1.5	T	9.11	9.91	--	--
	S	14.55	12.61	--	--
3	T	8.97	9.89	--	--
	S	14.49	12.78	--	--
4.1	T	--	--	17.00	--
	S	--	--	28.05	--
5.6	T	--	--	--	17.00
	S	--	--	--	27.74
6	T	9.10	9.84	--	--
	S	14.49	12.82	--	--
7.2	T	--	--	17.00	--
	S	--	--	27.83	--
8.7	T	--	--	--	17.00
	S	--	--	--	28.05
9	T	9.37	9.86	--	--
	S	14.49	12.82	--	--
12	T	9.40	9.84	--	--
	S	14.49	12.84	--	--

(1) CDM, 1972
(2) Bionomics Corporation (Appendix H)
(3) T=Temperature in °C
(4) S=Salinity in o/oo

N=Stations P, Q, R, North of Bridge
S=Stations T, U, V, South of Bridge

Table VI-4

CHEMICAL ANALYSIS OF SAN FRANCISCO BAY WATER
IN VICINITY OF DUMBARTON BRIDGE

Constitutent		Concentration[1]		
		2/16/72[2]	10/18/75[3]-N	10/18/75[3]-S
pH		8.1	--	--
Total Solids	ppm	30,631	31,800	32,400
Total Volatile Solids	ppm	5,488	--	--
Total Suspended Solids	ppm	44	--	--
Total Dissolved Solids	ppm	30,587	29,200	30,400
Alkalinity as $CaCO_3$	ppm	194	136	124
BOD	ppm	1.2	<1.0	<1.0
COD	ppm	255	--	--
Ammonia as N	ppm	0.06	<0.06	<0.06
Kjeldahl Nitrogen Total	ppm	1.10	2.00	2.28
Nitrate as N	ppm	0.72	0.83	0.83
Phosphorus Total as P	ppm	0.41	0.62	0.62
Chloride	ppm	17,000	15,800	16,000
Cyanide	ppm	<0.04	--	--
Fluoride	ppm	1.21	--	--
Phenols	ppb	<6	--	--
Sulfate as S	ppm	2,400	2,000	1,880
Sulfide as S	ppm	<2	--	--
TOC	ppm	18.5	--	--
Aluminum	ppb	200	--	--
Arsenic	ppb	<10	--	--
Cadmium	ppb	<20	<20	<20
Calcium	ppm	380	--	--
Chromium	ppb	<20	--	--
Iron	ppb	20	64	40
Lead	ppb	<20	<20	<20
Mercury	ppb	<1	<1	<1
Sodium	ppm	7,500	8,800	8,000
Titanium	ppb	<20	--	--
Zinc	ppb	30	4	3

(1) All tests by Standard Methods 13th Edition except Hg, Ti by WQO
(2) CDM, 1972, depth not specified.
(3) Bionomics Corporation (Appendix H).
N=Station Q (4.1 m) North of Bridge
S=Station U (5.6 m) South of Bridge

Table VI-5

COMMON SPECIES AT BENTHIC STATIONS NEAR DUMBARTON BRIDGE (1)

Estimated Numbers/Station(2)

Organisms (3)	Dumbarton Strait Stations					Ravenswood Point
	8	9	10	11	12	7
Polychaeta						
Streblospio benedicti	7	8	8	30	40	52
Asychis elongata	14	24	5	--	4	4
Marphysa sanguinea	7	--	--	--	--	10
Glycinde polygnatha	--	12	2	10	--	4
Neanthes succinea	8	--	--	--	--	--
Nephtys caecoides	--	5	1	5	--	--
Exogone lourei	--	8	--	6	--	19
Heteromastus filiformis	1	--	17	13	12	1
Harmothoe imbricata	--	--	--	--	--	2
Amaeana occidentalis	--	--	--	--	--	2
Bivalvia						
Gemma gemma	26	47	19	12	49	--
Lyonsia californica	8	5	53	28	--	--
Modiolus senhousia	52	185	60	9	106	13
Macoma inguinata	19	--	1	11	5	--
Macoma balthica	6	--	--	--	2	--
Tapes japonica	--	--	--	--	3	5
Arthropoda						
Ampelisca milleri	--	--	13	25	41	75
Oligochaeta						
Peloscolex apectinatus	264	200	120	8	80	8
P. gabriellae	--	--	--	24	--	24
P. nerthoides	--	--	--	1	--	--
Urochordata						
Ciona intestinalis	--	82	--	--	--	--

(1) Station locations shown on Figure II-15
(2) Four grabs/station with 0.05 m^2 surface area each.
(3) Species list based on Table II-9, Draft EIS.

Dumbarton Bridge is the Greco Island and Redwood Point marsh, bordered by Redwood Creek, Westpoint Slough and Ravenswood Slough (California Business and Transportation Agency, 1973). On the eastern side of the Bay, the major marsh habitat consists of the 750 acres near Newark and Mowry Sloughs (EPA, 1975).

Each of the marshes is typified by cordgrass, pickleweed and other marsh vegetation and provides prime habitat for locally endangered species such as the California clapper rail and salt marsh harvest mouse (Figure II-18). Portions of this marshland are in the San Francisco Bay National Wildlife Refuge (Figure II-23).

Salt Ponds

Salt Ponds (Figures II-14 and II-17) are a dominant feature in the vicinity of Dumbarton Bridge. The high salinity ponds and bittern storage ponds are poor habitat for aquatic animals; however, the lower salinity ponds do support moderate to heavy use by shorebirds which feed upon the invertebrate fauna growing in the ponds. Ponds at the western approach to Dumbarton Bridge, designated as 1, 2 and SF-2 on Figure II-17, are part of a series of low salinity ponds which is primarily on the east side of the Bay. Ponds 1 and 2 are included in the San Francisco Bay National Wildlife Refuge and, like the low to moderately saline ponds studied by Carpelan (1957), support a fairly diverse waterfowl population. Bollman, Thelin and Forester (1970) indicate that average bird counts per visit at these western ponds in 1964 were between 470 and 750 while the eastern ponds ranged from 610 to 770.

Three ponds at the eastern approach to the Bridge were surveyed by Dr. T. H. Harvey and Robert J. Gill, Jr. (California Business and Transportation Agency, 1973) for biological activity. These ponds, designated as 4, 6, and 9 on Figure II-17, were similar to the moderately saline ponds in the series studied by Carpelan (1957) in the Alviso series and supported large numbers of birds during the winter season of 1971-1972. California Business and Transportation Agency (1973) reports that almost 25 percent of the birds counted throughout San Francisco Bay in 1964 and 1965 were found on these three salt ponds.

Dikes and Levees

As described in Section II.1.2, dikes and levees provide relatively isolated habitat for salt marsh and salt tolerant species of plants and nest sites and refuge for birds and animals. The habitat provided by dikes, levees and other areas of fill is extensive in the Dumbarton Bridge area and contributes significantly to the value of salt marsh and salt pond habitat in this region.

Streams and Sloughs

Newark Slough, Mowry Slough and Ravenswood Slough are typical of streams and sloughs in the Dumbarton Bridge area. Each is a combination of open water, tidal mudflat, saltmarsh and levee habitat and each supports a diverse flora and fauna.

Newark Slough is five miles long from its mouth to just south of Silver Pines Golf Course in Newark, and ranges from 50 to 300 feet in width. Levees border the slough on each side, as much as 900 feet apart in some locations. Typical animal species are: shad, tomcod, surf perch, sharks, flatfish, rays and harbor seals in open water; mud snails, worms, clams, mussels and barnacles on the tidal mudflats; and California clapper rails, salt marsh song sparrows, salt marsh harvest mice and other birds and mammals in the marsh levee habitats (California Business and Transportation Agency, 1973).

Mowry Slough is known for its colony of 400 harbor seals (California Business and Transportation Agency, 1973) which are apparently increasing in numbers due to improved water quality and food supplies. These improvements have been attributed by the California Business and Transportation Agency to increased sewage treatment in the South Bay and Lower Bay.

Ravenswood Slough is about 1.75 miles long and varies in width from 100 to 400 feet. Despite periodic dredging, the slough is rich in marine invertebrates (California Business and Transportation Agency, 1973). Thirty-two species of birds (about 4,000 individuals) were observed in and near the slough in February, 1971, by Dr. J. P. Mackey (California Business and Transportation Agency, 1973), indicating that this slough is excellent habitat for waterfowl and other wildlife.

Other sloughs and streams in the Dumbarton Bridge vicinity are Westpoint Slough, Redwood Creek, Smith Slough, Deepwater Slough, Steinberger Slough, Corkscrew Slough (all in or near the Greco Island and Bair Island Units of the San Francisco Bay National Wildlife Refuge), Plummer Creek, Patterson Creek and Coyote Hills Slough (all within the Fremont, Alameda County Unit of the Refuge).

Species of Special Concern

As described in Section II.1.2, approximately 18 animal species which are known to occur in the South Bay area are "species of special concern." The ranges of these species, as shown in Figure II-18, do include the Dumbarton Bridge vicinity. In addition, two shellfish beds, one at Ravenswood Point and the other at Dumbarton Point, are found near the bridge. These beds, consisting of Japanese littleneck clams, Bay mussels, softshell clams and native oysters, are prohibited for human consumption. due to contamination from urban runoff and wastewater discharges.

VI.2.3 SOCIAL AND CULTURAL ENVIRONMENT

Recreational Uses of the Area

As described in Section II.1.3, recreational use of the South and Lower Bays is extensive and varied, and the various city and county plans (Section II.2.2) have incorporated extensive parkland and recreational features which will likely increase this use. Recreational areas near the Dumbarton Bridge have been described in Sections II.1.3 and II.2.1. Briefly, they are, in San Mateo County:

- San Francisco Bay National Wildlife Refuge
- Boat harbors at Port of Redwood City, Redwood Shores, and Foster City

- Marine World/Africa U. S. A.
- Duck Club on Ravenswood Point

and in Alameda County:

- San Francisco Bay National Wildlife Refuge
- Coyote Hills Regional Park
- Golf Course at Newark (Silver Pines)

Archaeological, Paleontological, Historical, and Cultural Resources

Surveys by the Adan E. Treganza Anthropology Museum for the East Bay Dischargers Project (EPA, 1975) and by Jerald Johnson of California State University at Sacramento for the South Bayside project (SCSP Committee, 1974) revealed no archaeological or anthropological sites in the salt pond and marsh areas near the Bridge. However, as in the survey described in Section II.1.3, the possibility of archaeological sites in the vicinity of stream beds is high, particularly at Coyote Hills and Newark Slough.

No historic sites or landmarks have been identified for this area but Rancho grant properties such as Rancho Pulgas dominate the shorelines. Cultural artifacts could be encountered throughout the area, particularly during construction activities. These cultural artifacts include Mayhew's Landing (or Beard's Landing), an historic dock used by the original families of Fremont to ship goods to San Francisco (California Business and Transportation Agency, 1973).

Visual and Aesthetic Setting

The western abutment of the Dumbarton Bridge, the radio towers for stations KNBR and KGEI, overhead power lines and scattered abandoned buildings dominate the aesthetic setting of the Bair Island, Greco Island and Ravenswood Point area. Similarily, in Alameda County, the eastern approaches to the bridge and KGO radio towers are major visual influences.

Existing and Proposed Land Use

Sections II.2.1 and II.2.2 describe existing and proposed land use in Santa Clara and San Mateo County (see also Figures II-23, II-24, and II-25). In the vicinity of the western abutment of the Dumbarton Bridge, existing and planned uses are primarily related to the San Francisco Bay National Wildlife Refuge, the Leslie Salt Company and scattered commercial, industrial and utility uses.

The area around the eastern abutment of the Dumbarton Bridge, in Alameda County, is not described in detail in Section II.2. However, existing and planned uses are similar to those at the western abutment, including use by San Francisco Bay National Wildlife Refuge and Leslie Salt Company's salt evaporation system. Within the Fremont Planning Area (EPA, 1975), the acreage around the Bridge is dedicated in its entirety to parkland and open space.